The Journal of Electricity

An Illustrated Review of the Industrial Applications of Electricity, Gas and Power.

APRIL TO SEPTEMBER

1897

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Some Details of the Fresno Plant.

The Journal of Electricity

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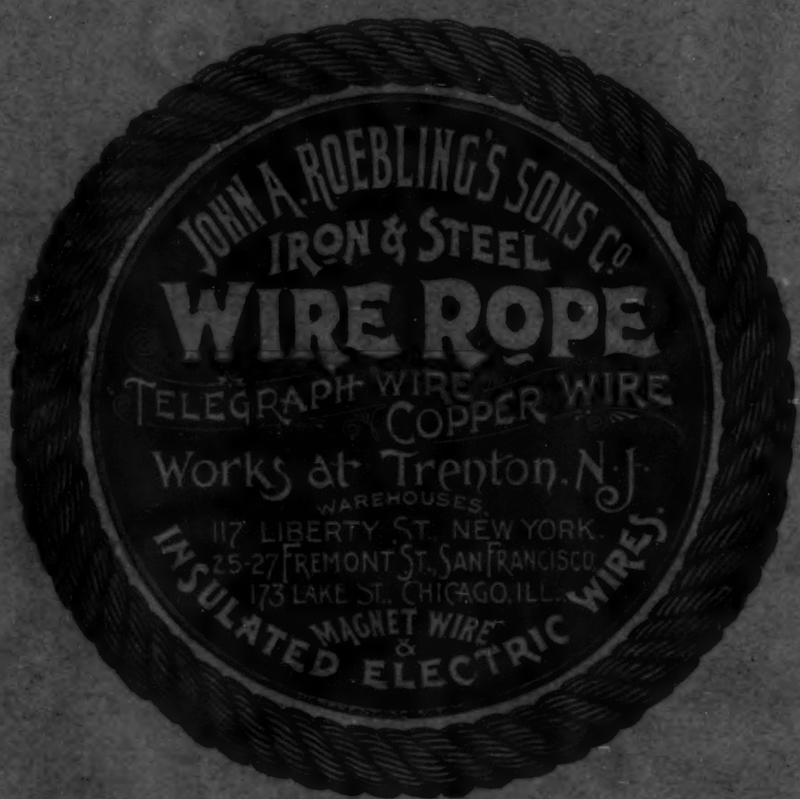

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The Journal of Electricity

VOL. IV. APRIL, 1897. No. 1

Some Details of the Fresno Plant.

BY C. E. DUTCHER.

Much has been published concerning the long distance electrical transmission plant of the San Joaquin Electric Company at Fresno, Cal., and none of the descriptions yet issued equal in any regard that appearing in the Journal of Electricity for April, 1896. There yet remains to be told, however, the technical details of the electrical operation of the plant, and this is the purpose of the present article.

Briefly described, the equipment is of the apparatus of the General Electric Company throughout. At the power house are three 350 kilowatt 700 volt, 60 cycle, three-phase generators, each driven at a speed of 600 revolutions per minute, by separate five-foot Pelton wheels running under a head of 1410 feet. This gives a pressure of 609 pounds per square inch at the nozzle which is the highest pressure at which any electrical transmission in the plant in the world is operated. The wheels are governed by Replogle governors which confine the variations in speed to within two per cent from that at normal operation. The power house also contains two 12½ kilowatt 125 volt, multipolar exciters, each driven at a speed of 1278 revolutions per minute, by separate Pelton wheels operating at a constant pressure of 200 pounds per square inch. These wheels are supplied by a separate pipe line which takes water from a small auxiliary reservoir that in turn is supplied by the main pipe line at a point about one-third of the way up the mountain. The details concerning the remaining portions of the plant will appear hereafter.

FIGURE 1.—"ELECTRIC FALLS"—DIVERTING POINT OF THE SAN JOAQUIN ELECTRIC COMPANY.

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The generally accepted practice in switchboard construction for almost every class of work consists in arranging the appliances thereon so that the instruments shall appear in consecutive order from the top of the board as follows: Lightning arresters, cut-outs, ammeters and voltmeters, main switches, and lastly, the rheostats. The reasons for this procedure are rational ones. Switchboards of modern construction do not give origin to serious trouble in any form. All troubles that occur arise outside of and beyond the switchboard and of these troubles the most serious is lightning, hence the lightning arrester is placed at the point of entry of the line wires to the switchboard. Grounds, swinging crosses and "dead shorts," form the chief remaining sources of trouble and protection against them is had in the cut-out, hence that appliance is almost invariably introduced into the circuit after it has passed in through the lightning arrester, thus affording protection to the switchboard appliances from overload. Next follow the ammeter and voltmeter, located at points most readily meeting the eye; beneath them and placed where most convenient for instantaneous handling are the main switches while at the bottom of the board are the field rheostats, as conveniently placed for ready handling as is possible, but less so than the main switches, because of the two the latter demands more prompt and decisive manipulation. In addition, behind the board are generally placed a cut-out in each dynamo lead before it enters the bus bars. There is a motive actuating both the existence and location of all devices on a modern switchboard for there exists the nerve center of the whole system.

The switchboard at the power house of the San Joaquin Electric Company is built after this plan with the one exception that cut-outs are not introduced into the line. The scheme of operation will be understood by reference to the accompanying cuts in which Figure 2 illustrates the face of the power house switchboard and on Diagram 1 are shown the circuit connections as exist on the back of the board.

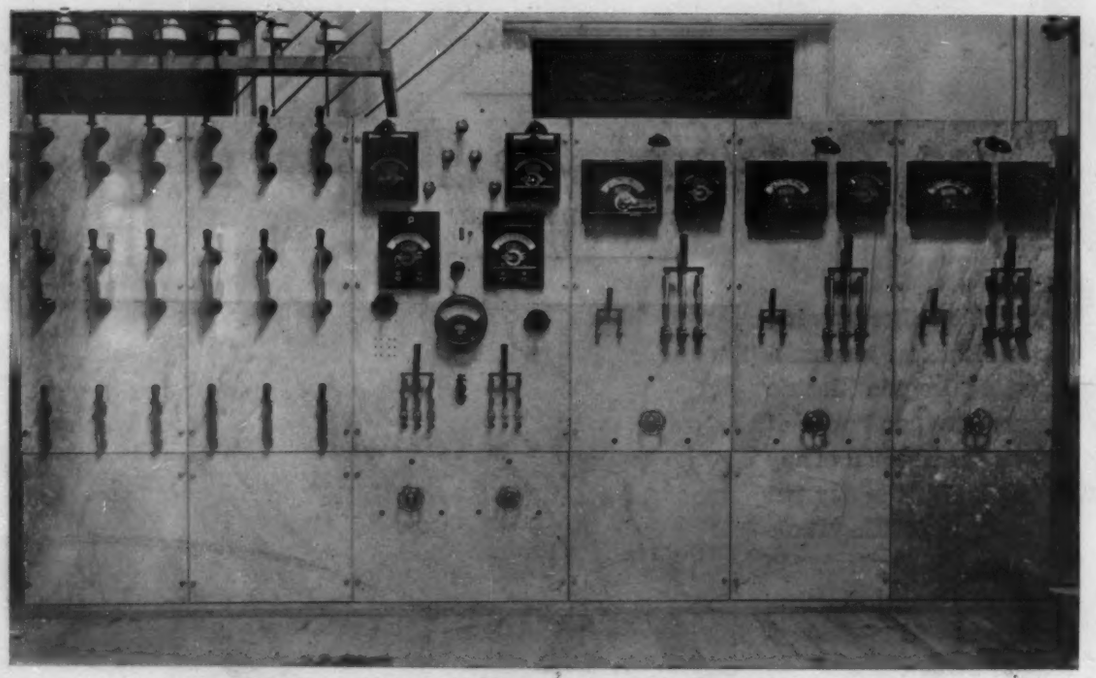


FIGURE 2.—GENERATOR, TRANSFORMER AND LINE SWITCHBOARD AT THE POWER HOUSE OF THE SAN JOAQUIN ELECTRIC CO.

At the outset it should be stated that appliances at the power house are designated by letters or figures which are read as they appear from left to right while at the sub-station in Fresno the reverse occurs and the reading is from right to left. The generators, transformer banks and line circuits are designated numerically, and the leads of the three-phase circuits are designated by the letters A, B and C, as they appear on the power house switchboard.

Referring again to Figure 2, the six panels constituting the switchboard (beginning the numbering from the left) are as follows: Transformer Bank and Line Number 1; Transformer Bank and Line No. 2; Exciters and Generators numbered 1, 2, and 3 respectively. The three horizontal rows of switches on the transformer and line panels are for the control of (1) the lines, (2) the high potential bus bars and (3) the primaries of the step-up transformers respectively. On each of these two panels the three vertical rows of switches control leads A, B and C of their respective devices, hence with all switches thrown in as shown in the illustration the primaries of both banks of step-up transformers are taking current from the generator bus bars, while the secondaries of both banks are delivering a potential of 11,200 volts to the high tension bus bars through the second row of horizontal switches, whence current is supplied to the three legs of both line circuits. This simple switch arrangement enables the cutting out of

either bank of transformers during light load and the utilization of either or both of the transmission lines as desired.

The third, or exciter panel, is a compound one in that it carries the switchboard appliances for both exciters and the other devices peculiar to the operation of a three-phase plant. The exciters are provided with a Weston voltmeter and switch for throwing the voltmeter on to either exciter. Four potential indicators also appeal in this panel immediately below the ground detector and each set of two potential indicators has an independent transformer by means of which the generator and bus bar potentials are indicated as are also the generator and bus bar pilot lamps and the synchronizing lamps. At the sides of the Weston voltmeter are four sets of plug switches with two, four-legged plugs by means of which the potential of either generator and of the bus bars may be determined as is necessary in synchronizing generators. The upper right hand switch is used solely to give the bus bar potential and the remaining three switches, which appear on the switchboard as merely twelve holes in a group, are for generators 1, 2 and 3 respectively as shown in Diagram 2.

These plug switches are simple, yet ingenious devices. In three-phase work it is not essential to know the voltage of each circuit at all times, but it is necessary to learn the potential of the circuits at irregular intervals or whenever the load on any side varies.

The use of but a single voltmeter and voltmeter transformer, therefore, suffices for determining the voltage of all the generators, but as each generator has three circuits, there are consequently nine circuits into which the voltmeter must be cut and the plug switch referred to has been adopted as the most simple and ready means for doing this work without affording the slightest possibility for short-circuiting. Reference to the diagram will show the circuit connections of the plug switches which are shown to consist of two simple bars having three holes in each and forming the voltmeter terminals, besides two shorter bars, each having two holes and placed outside the voltmeter bars. These short bars are staggered so that the first one spans the two upper horizontal rows of holes of the switch, while the lower one spans the two lower horizontal rows of holes. The short bar in the upper left hand corner is connected to leg C of a given generator; the short bar in the lower right hand corner is connected to leg B of the same generator, while the remaining leg A is presented in the diagonally opposite holes of the remaining corners. The four-legged plug shown in Figure 2 consists of a bar of ebonite with a circular hand shield and from which project four metal pins, numbers 1 and 2 of which are short circuited together, as are also pins numbers 3 and 4. In Figure 2 the plug is shown inserted in the upper row of holes of the potential switch for generator No. 1, (see diagram No. 1) hence the reading on the generator voltmeter gives the reading of

FIGURE 3.—RESERVOIR OF THE SAN JOAQUIN ELECTRIC COMPANY.

circuit A C of that dynamo. Similarly the four-legged plug switch at the right of the Weston voltmeter gives on the bus bar voltmeter the potential of bus bar circuit A B.

On the face of the switchboard are four potential indicators, but for simplicity only two of them are shown in Diagram 1. Of these four, two voltmeters are placed in parallel across each switchboard transformer, and the entire group forms a series-multiple with the lamp circuits. The readings of the two voltmeters on the same transformers are, therefore, alike, but it is found that their presence facilitates quickness in observation and switching. The voltmeter transformers reduce the potential from 700 volts to 100 volts.

grounded side is cut out, causing the remaining lamp to take full voltage.

In the three-phase ground detector, a single lamp as shown at the apex of the triangle of lamps on the face of the switchboard, is used, but is in series with a choke coil as shown in the diagram, for cutting down the potential applied to the lamp from 700 volts to 100 volts. Immediately above the Weston voltmeter is the ground detector switch, consisting of four holes, three of which form the points of an equilateral triangle and the fourth one is centered therein as appears in the drawing. A two-legged plug is used, which bridges between the center hole and either of the three outside ones. The center hole leads to earth through the choke coil and lamp, while the remaining

FIGURE 4.—ELECTRIC PUMPING STATION AND RESERVOIR OF THE FRESNO WATER COMPANY.

The ground detector is an adaptation of the two-lamp detector common in two-wire incandescent installations and in which two 100-volt lamps in series are placed across a 100-volt circuit, the connecting wire between the two lamps being put to ground through a snap or plug switch. Normally, each lamp burns to but one-half candle power, but on throwing on the ground wire of the detector, if either side is partially grounded or is dead grounded, one lamp dims and the other brightens, or the first lamp goes out altogether and the other comes up to full candle power according to the seriousness of the ground, for if a lead is dead grounded, the resistance of the lamp on the contacts lead to the three generator bus bars respectively. If the plug grounds leg B through the lamp and choke coil as shown in Figure 2, the lamp will burn dim if partially grounded or it will not burn at all if it is on a dead ground, while if the plug grounds the remaining bus bars through the other two holes, the lamp will burn brightly in each case, signifying that the bus bars A C are clear of grounds.

The form of lightning arresters used is described in the article referred to, but it may be stated here that it is of the Wirt type as exclusively used by the General Electric Company in high potential transmission installations. It is not a non-arcing arrester in

the sense in which the term is usually applied, but instead,its action seems to be one of breaking the discharge into numerous small sparks that jump the small air gaps between the metal balls which appear to chill and put out the discharge as effectually as if of non-arcing metal.

The connections of the exciter on the exciter panel follow ordinary practices, hence, as they present no unusual features, they are not detailed. It is clear from the diagram that the exciters feed into a set of exciter bus bars which is continued to the right along the back of the generator panels. From these bus bars current is taken to the fields of each generator through an independent double-pole switch, a field rheostat and an ammeter, the latter being located in the upper right hand corner of each generator panel. The three remaining panels are for the respective generators, each of which feeds into the set of bus bars through 350 ampere fuses and a triple-pole switch. The B lead of each generator feeds into its bus bar through a current indicator shown in the upper left hand corner of each generator panel. It is evident from Diagram 1 that the lower set of bus bars on the transformer panels are but a continuation of the generator bus bars on panels 4, 5 and 6.

With the exception of the location of the ammeters, the switchboard connections of these three-phase generators are practically the same as those for an Edison three-wire system in which as many dynamos are run in parallel as are required to carry the load. This is exactly that which is done with the three-phase generator in the power house of the San Joaquin Electric Company. The generators run singly or in parallel with equal facility, in fact the station attendant who has operated incandescent dynamos or street railway generators in parallel will experience no difficulty in paralleling three-phasers after he has learned how to synchronize them. Like direct current generators, three-phasers when operating in parallel must be up to voltage (in addition to being "in step") before being thrown together, then its portion of the load must be thrown on to the second machine by increasing its voltage and equalizing the speed and if the voltage or speed of the second generator falls below that of the

FIGURE 5.—FRESNO MILL OF THE SPERRY FLOUR COMPANY, IN WHICH ELECTRICALLY TRANSMITTED POWER HAS SUPPLANTED STEAM.

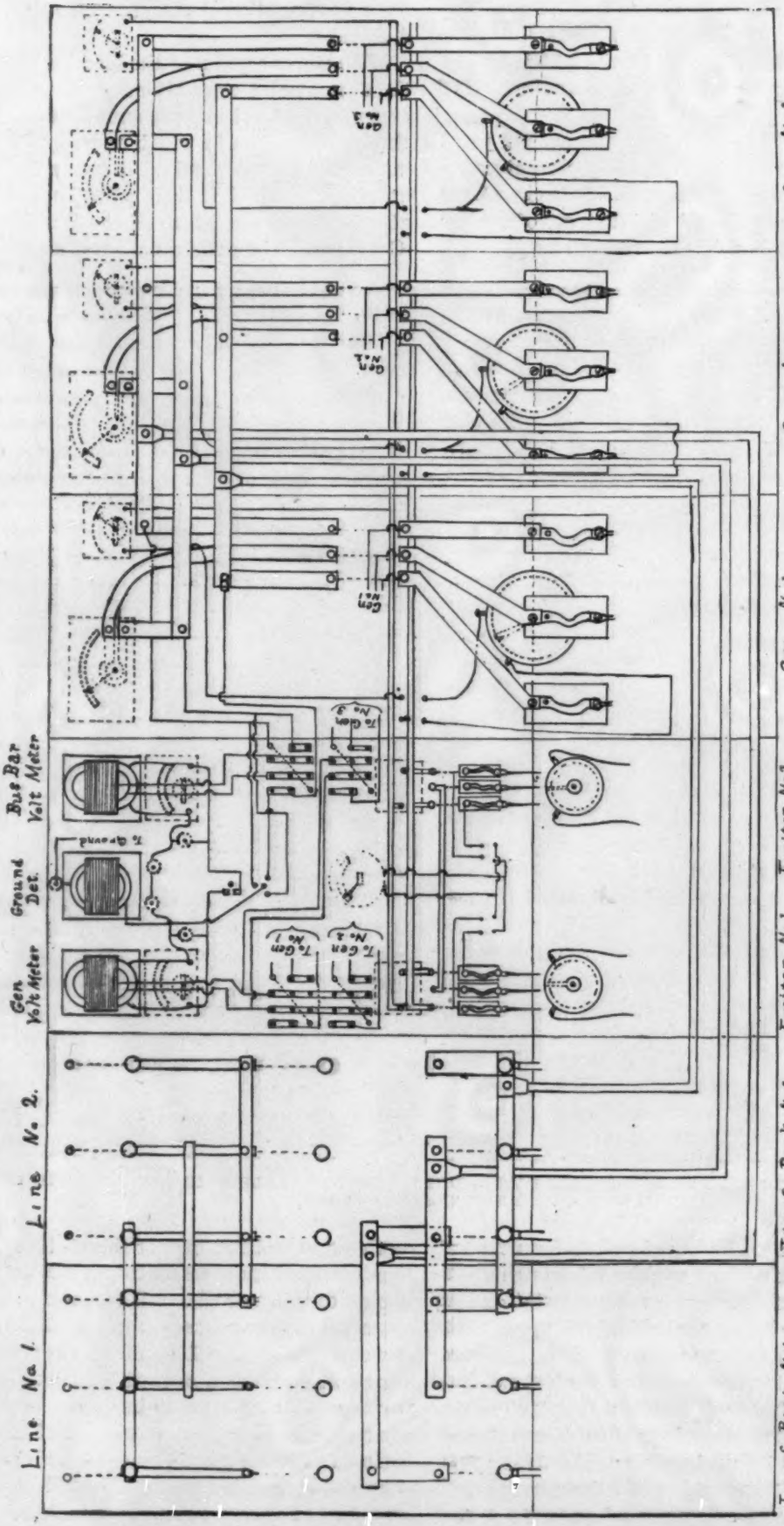


DIAGRAM 2.—DETAILED CIRCUIT CONNECTIONS OF THE GENERATOR, EXCITER, TRANSFORMER AND LINESWITCHBOARD IN THE POWER HOUSE OF THE SAN JOAQUIN ELECTRIC CO., AS ILLUSTRATED ON PAGE 2.

other it will be driven by the latter as a motor throwing additional load onto the first generator or the one having the higher speed and voltage.

Before proceeding to a description of the method of synchronizing it may be well to point out that the plant is never started, nor are the existing conditions altered in any way without consultation by telephone between the power house and the Fresno sub-station. The telephone line is carried on the transmission poles on independent cross arms placed thirty inches below the high potential circuit; it is transposed every mile, yet despite the distance (thirty-five miles) the line is silent and conversation is readily carried on at any time. In starting, the exciter is first brought up to speed, the field circuit of generator No. 2, for instance, is closed and the excitation is adjusted to the proper voltage after the manner of starting up an ordinary single-phase alternator. The generator is then brought up to speed when the main switch on the generator panel is closed, setting the entire plant in operation as the switches on the transformer panels would have been properly set before starting up. If now, the load increases beyond the capacity of generator No. 2 and it becomes necessary to put generator No. 1 in service, the field switch on generator panel No. 1 is closed, (a single exciter has sufficient capacity to operate all three generators) the voltage of one of the three-phase circuits is taken by inserting the four-legged plug in one of the horizontal rows of holes of the upper right hand plug switch which will take the position shown in Figure 2. When the potential of the generator equals that shown on the bus bar voltmeters, the impulses of electro-motive force of each generator must be brought into step or into synchronism with each other. This is done by means of the synchronizing lamps.

On the face of the switchboard appears five incandescent lamps; the upper one is as stated for the ground detector; the middle two are the synchronizing lamps and the lower two are pilot lamps, one for the generator and one for the bus bars. The mode of connecting the lower four lamps is clearly shown in Diagram 1, where the pilot lamps are seen placed across their respective transformers, while the synchronizing lamps are in series with each other and the transformers, but with the circuit interrupted by a plug switch. On closing the lamp circuit by inserting the plug, the two voltmeter transformers work in opposition, in part opposition, or together in burning the synchronizing lamps, according to whether their respective generators are altogether out of phase, or whether they are partly in step, or whether they are synchronous. The lamps, therefore, blink according to the conditions of the phases and when a long wave or blink of the lamp occurs at an instant when the lamps burn at full incandescence, the main switch of generator No. 1 is instantly closed, after which the lamps burn without fluctuation, showing that the generators are synchronizing. The field of generator No. 1 is then increased until it has taken its proper share of the load and the same mode of procedure is followed in putting the remaining generator in service. The three-phasers are cut out of service precisely as would be done with a railway generator.

Of course the banks of step-up transformers, which have both primary and secondary coils wound in delta, are cut on or off from the generator bus bars according to load by the use of two lower arms of single-pole switches on the transformer panels. The lowest row controls the 700 volt primary entering the step-up transformers; the middle row of switches cuts the 11,200 volt secondary (the transformers have a ratio of 16 to 1) on to the high potential bus bars, while the line circuits are fed from these bars through the upper row of single pole switches. The apparatus of the station is in duplicate throughout and is so installed that any part of it may be disconnected from service at will.

The construction of the transmission line has been fully described in the article previously referred to, hence it is sufficient to state that it consists of two three-phase circuits of No. 1 B. & S. bare hard drawn copper wires carried on two eight-foot cross arms supported by 40 foot poles. Legs A and B of each circuit are placed equi-distant on the top cross-arm and leg C of each circuit is placed centrally on the lower arm so that in a sectional view the wires form the points of an inverted equilateral triangle with sides twenty-four inches apart. Triple petticoat porcelain insulators are used throughout.

The manner in which the main line enters the sub-station in Fresno is clearly shown in Diagram 2, and after passing through the lightning arresters and choke coils, the lines terminate at the clips of the upper row of single pole switches on the high potential board. The fulcrum of these switches cut into the high potential bus bars which are a counterpart of those on the high potential board at the power house. Indeed, the same scheme of switching prevails in both instances, but in reverse procedure, viz: the utilization of either line or transformer circuit, single or in parallel with the other as desired. From the high potential bus bars in the sub-station the three-phase current is led through single pole switches to three sets of step-down transformers of the General Electric Company's air blast type. Each of these three banks contain three transformers; those in the first set each have a capacity of 125 kilowatts and reduce the potential from 10,000 volts to 125 volts. The primaries are wound in delta while the secondaries are wound Y with a common neutral, hence it delivers 125 volts between either of leg A, B and C and the neutral wire or 200 volts between legs A, B and C alone. The second and third sets consist of 75 kilowatt and 40 kilowatt transformers respectively; they are wound delta in all parts and take current at the line voltage delivering it at 1000 volts. The entire three sets are placed in operation by the row of single pole switches extending horizontally along the middle of the high potential

switchboard and their secondaries are broken by the single pole switches on the lower rows of their respective panels all as clearly shown in Diagram 2.

The entire incandescent lighting load, as well as the small motor load, is carried by transformer set No. 1 in which, as stated, the secondaries are wound in Y. The neutral wires of these transformers are connected together to a single wire which leads through a single pole switch shown at the bottom of a panel of the low tension distributing board whence it proceeds out of the distribution lines. The remaining legs are cut into the bus bars of the incandescent distributing board extending from panel 2 to 6 inclusive, through current indicators. Seven circuits are taken from these bus bars, five of which are included between panels numbered from 2 to 6 inclusively, are used for incandescent and small motor service as stated, while the remaining panel or panel No. 1, at the extreme right hand end of the board, operates two 60 horse-power 200-volt induction motors which are direct connected to two 80-light Brush arc dynamos. The characteristics of the switchboard will be understood by reference to Diagram 2, from which it will be seen that the current entering the low tension bus bars from Transformer set No. 1, is thrown into the bus bars direct without any intervening device. From the bus bars current is thrown to the various distributions through triple pole switches, whence it proceeds through potential regulators or boosters to line after passing through cut-outs and the ammeters shown at the top of the board. From each of the various distributing centers about the city four pressure wires are run back to the sub-station switchboard as in the Edison three-wire system.

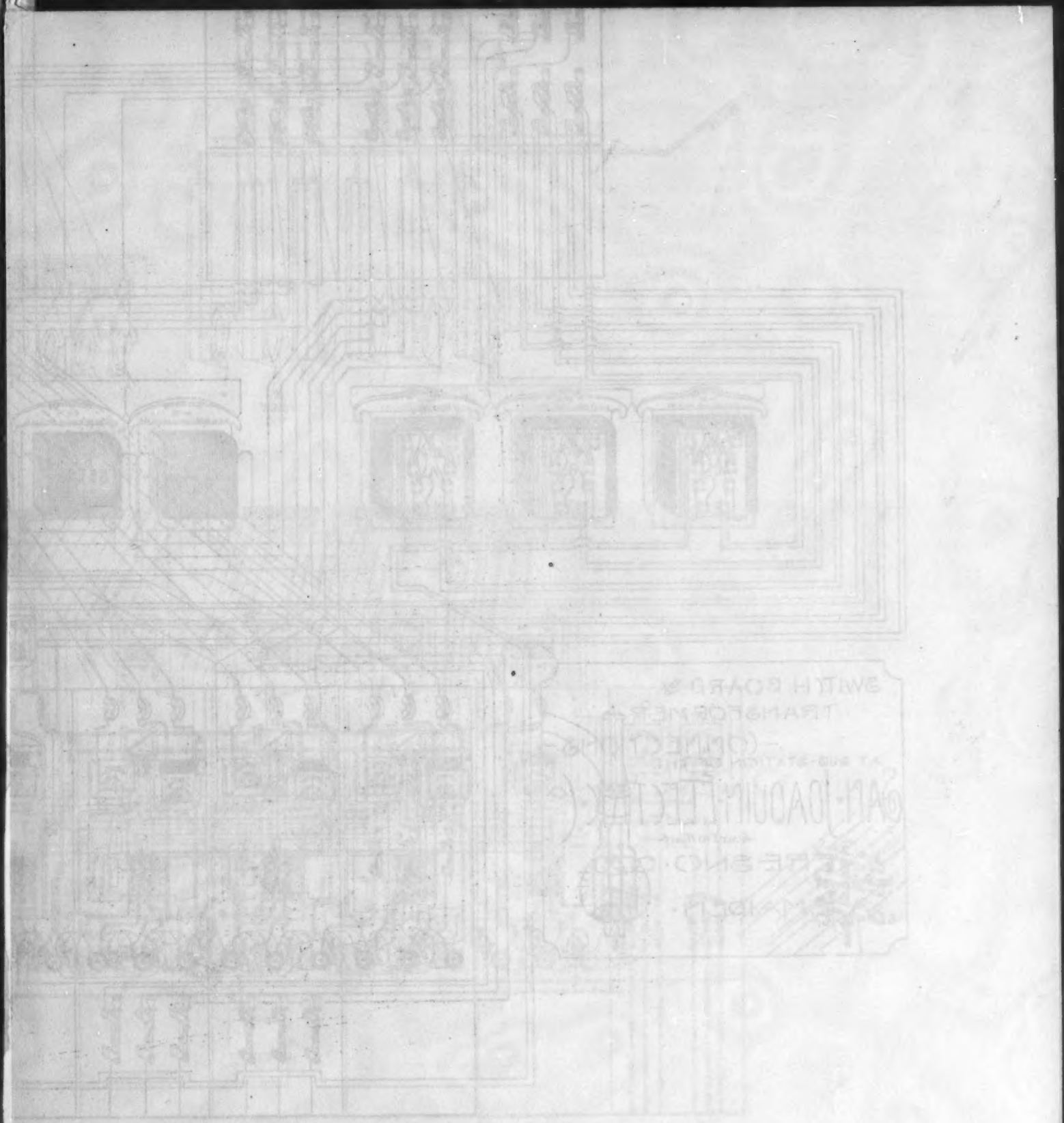
These pressure wires terminate in the three-point switches appearing on the low tension panels and by means of which the voltages of the various legs of the circuit to neutral are shown. The boosters referred to are connected in series with the outgoing leads. These regulators consist of two stationary coils placed at right angles to each other and fitted into four large slots in an exterior stationary magnetic iron circuit. Within the coils is an iron core which may be turned in relation to the stationary field so that by moving the core a portion of a revolution the field set up by the primary coil may be shifted in its direction so that more or less lines of induction will interlink with the secondary coil and thus produce an increase or decrease in the secondary potential.

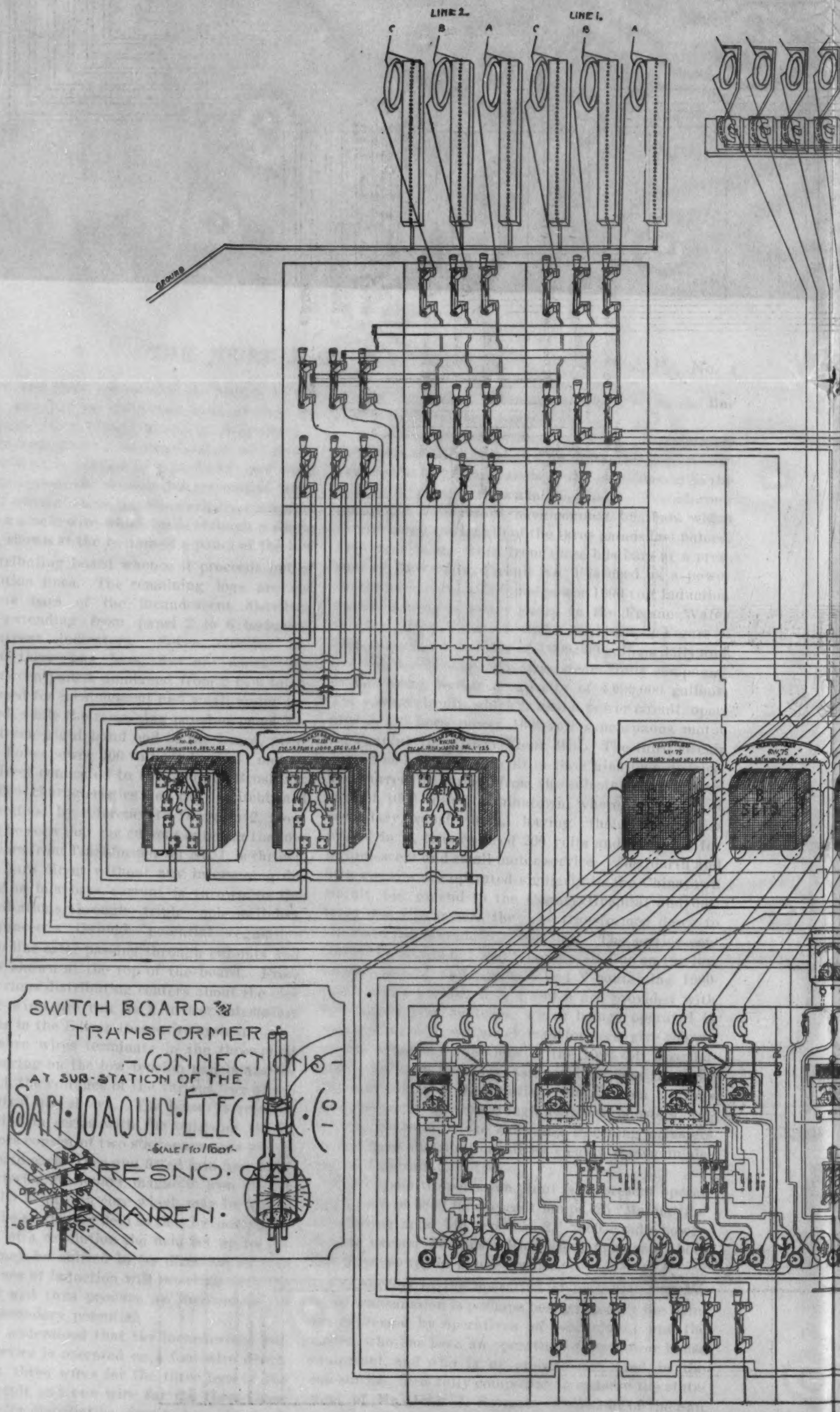
It should be understood that the incandescent and small motor service is operated on a four-wire distribution; that is, three wires for the three legs of the three-phase circuit and one wire for the three-phase neutral. The city distribution circuits have five feeding-in points corresponding to the five panels referred to and should the potential of any distributing center vary to an extent greater than that which can be corrected by the boosters, it is the practice to equalize by breaking the circuit of that leg of the center which shows the highest pressure, in which event the line loss is made to compensate.

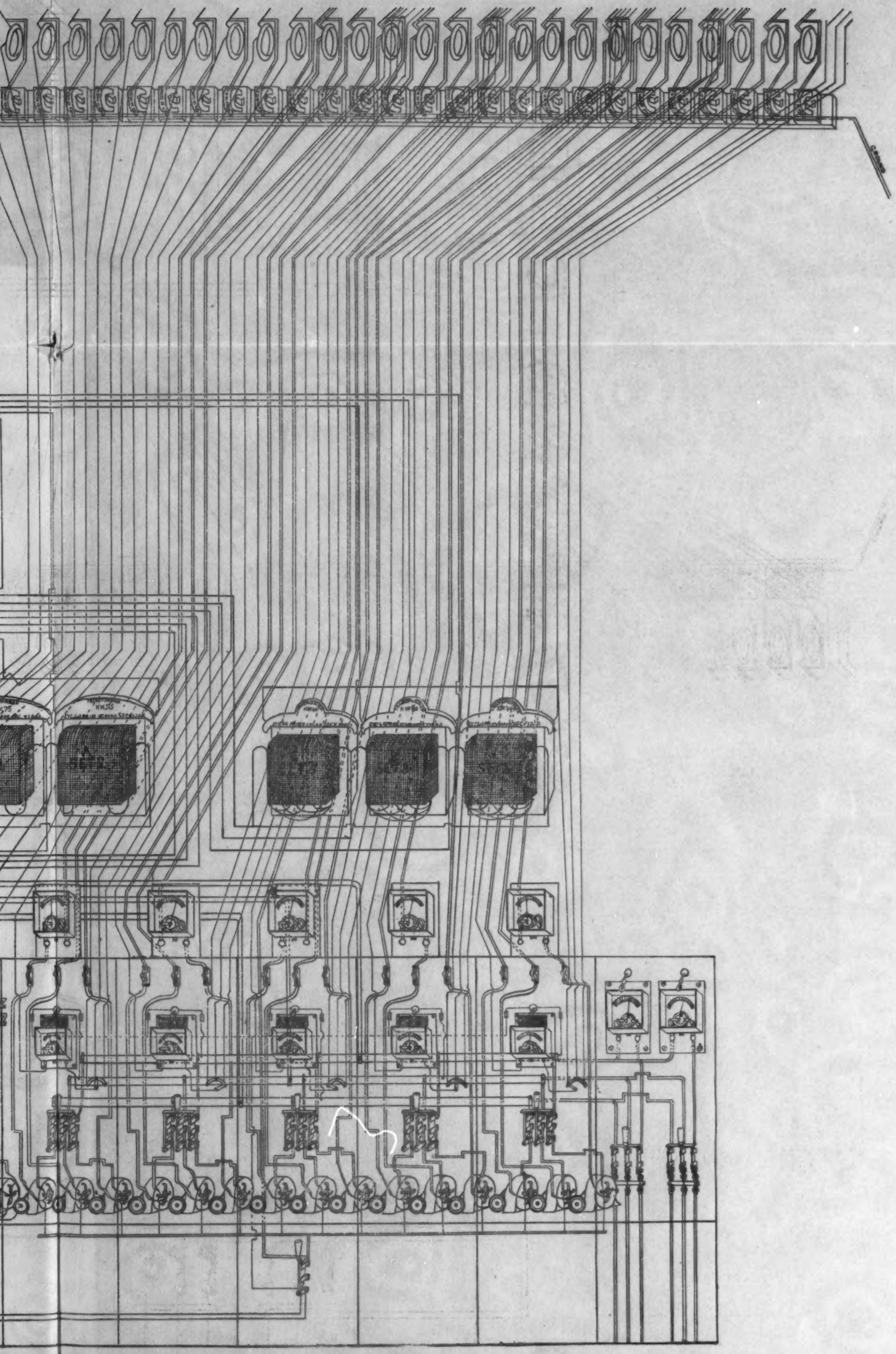
As stated, the remaining step-down transformers have secondaries connected in delta and deliver current to the last three panels of the switchboard to the left, in the manner shown in Diagram 2. Transformer sets 2 and 3, therefore, have common bus bars which extend along the length of the three panels last named. Five circuits are taken from these bus bars at a pressure of 1000 volts: Circuit No. 1 is used as a power circuit to operate a 75 horse-power 1000-volt induction motor, driving a rotary pump in the Fresno Water Works, the exterior of which is shown in Figure 4. This pump has a capacity of 3,000,000 gallons daily and has displaced the use of a large steam Holly compound duplex pump having a capacity of 4,000,000 gallons. The second circuit, which is also a power circuit, operates a 180 horse-power 1000-volt synchronous motor for running the Sperry Flour Mill. The third circuit is used as a lighting circuit in the Chinatown district. The current is carried from the sub-station at a pressure of 1000 volts to Chinatown, where, by means of secondary transformers, having their secondaries wound in Y, it is reduced 200 volts and 115 volts for incandescent and small motor service. The fourth and fifth circuits are operated similarly to the Chinatown circuit, but extend to the County Hospital and outlying districts, where they are transformed down to 115 volts for incandescent lighting. The service controlled by panels 6, 7 and 8 is regulated as on the low tension panels, and panels 6 and 7 containing 1000-volt circuits numbered 3, 4 and 5 are provided with four-legged plug switches, which being operated in conjunction with voltmeter transformers, give the potential between either legs of the 1000-volt distribution. As in the previous instance, it is clear from the diagram that this distribution comes from the bus bars, proceeds thence through switches, boosters, ammeters, cut-outs, choke coils and lightning arresters to the local distribution all as clearly shown in detail on Diagram 2.

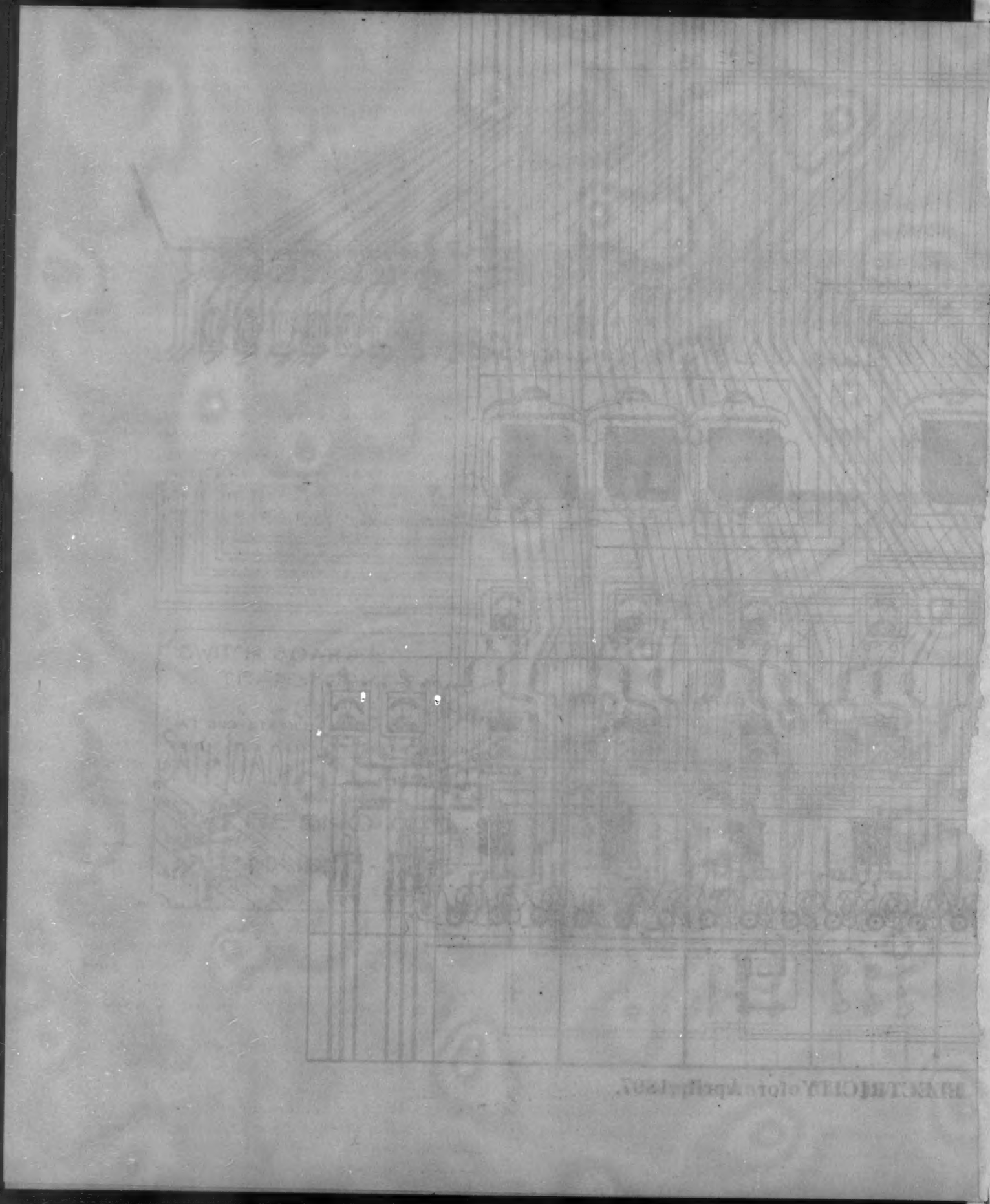
The Fresno transmission plant is at present operating a load of 5800 incadescent lamps, 25 "Manhattan" alternating arcs, 148 type "M 2," 2000 candle-power, double carbon Thompson-Rice arc lamps and about 525 horse-power in motor service.

The success of the operation of long-distance electrical transmission is perhaps best gauged by the opinion expressed by operatives of the plant, and the writer, who has been an operative of the power house equipment, and who is at present employed in the sub-station, feels fully competent to endorse the statement of Mr. John J. Seymore, President of the San Joaquin Electric Company to the effect that all the machinery has worked with perfect success from the start. The incandescent lights have most of them been newly wired in thus enabling a proper balance of the load and the regulation has given no trouble whatever.




LINE 2.
C
B
A
LINE 1.
C
B
A
GROUND
SWITCH BOARD &
TRANSFORMER
-CONNECTIONS-
AT SUB-STATION OF THE
SAN·JOAQUIN·ELECTRIC·CO
-SCALE FIG 1 FOOT-
FRESNO·
MAIDEN·





In conclusion, the writer desires to express appreciation of the services of Mr. A. E. Maiden, switchboard attendant at the sub-station, for the care and fidelity with which he has executed the circuit drawing, from which Diagrams 1 and 2 are reproduced, and which are drawn to scale in every detail.

THE SMITH-MANIFOLD CALCULATOR.—IV.

By Geo. P. Low.

The energy of a given circuit is expressed in watts and 746 watts are required to produce one electrical horse-power, while 1000 watts constitute a kilowatt, which is the unit of energy measurements generally accepted in commercial transactions. The electrical energy is derived in the product of the volts and amperes of a circuit and probably the very simplest of the many uses to which the Smith-Manifold Calculator may be put are in the determinations of wattages and electrical horse-powers together with their component functions. When the volts and amperes of a circuit are given and it is desired to know its wattage, the Calculator stands ever ready to save the time that a problem in multiplication would otherwise consume. Moreover, it is absolutely mistake-proof.

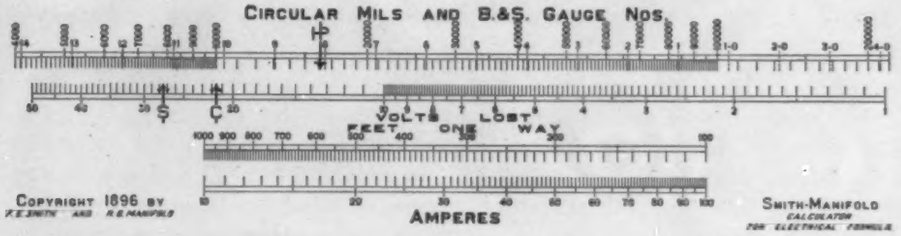


FIGURE 1.—THE SMITH-MANIFOLD CALCULATOR.

Eleventh Example: What is the wattage of a motor taking 31.6 amperes from a 220-volt power circuit,

To solve this and all kindred problems, read amperes direct on the ampere scale; read volts direct on the feet-one-way scale, and read watts direct on the circular mils scale. Adjusting the Calculator after this manner for the factors given, 31.6 amperes is placed opposite the 220-volt mark as in Figure 3, when above the arrow "C" on the circular mils scale is read 6950, the watts required.

Twelfth Example: What current is required to operate a 20 kilowatt 220-volt motor to rated capacity?

Proceed in the manner outlined by placing the arrow "C" opposite 20,000 watts (20 kilowatts), then under 220 volts on the feet-one-way scale is read 90.9 amperes, the current required.

Evidently to continue in the elaboration of so simple a procedure would be redundant, hence without further explanation is given:

Rule 2. To find the wattage of a circuit: Read watts direct on the circular mils scale; read volts direct on the feet-one-way scale and read amperes direct on the ampere scale, then the product of the amounts shown by opposite marks on the feet-one-way and ampere scales gives the watts indicated on the circular mils scale by the arrow "C."

The calculation of electrical horse-power is equally simple and from what has been said it is clear that the ordinary method of deriving the electrical horse-power of a circuit is to divide its wattage by 746. Long division at best is irksome, but it is a positive exasperation when means are at hand for performing its work instantly by a mechanical device such as the Smith-Manifold Calculator.

Thirteenth Example: Required the electrical horse-power of a circuit carrying 40 amperes at 500 volts.

Let the figures on the feet-one-way scale represent volts direct, then place the mark indicating the proper voltage so derived, and which in this example is 500, opposite the stated current or 40 amperes, when the scale appears as in Figure 2. Immediately under the horse-power arrow on the circular mils scale, then appears the required electrical horse-power direct or 26.8 e. h. p. Were the current but 20 amperes at 500 volts, the energy would evidently be but one-half of that amount or 13.4 electrical horse-power which is shown in the Calculator setting appearing in Figure 1. It is also obvious that under Rule 2 the wattage of these two circuits would be 20,000 and 10,000 respectively.

Fourteenth Example: After deducting all losses it is found that a constant current motor to be run on an 18 ampere circuit must absorb therefrom 9.35 electrical horse-power. What will be its voltage?

Place the Calculator as in Figure 3 with the horse-power arrow on the 9.35 mark (e. h. p.) on the volts lost scale, then over 18 amperes read 387 volts, the potential required. We have also seen that from Rule 2, the energy consumed by this motor will be 6.95 kilowatts.

Fifteenth Example: A 2200-volt alternator is putting out 11 amperes on the primary circuit. What is the electrical horse-power?

As 2200 does not appear on the feet-one-way scale, it is necessary to drop a cipher therefrom and bear in mind that the result read on the calculator must be multiplied by ten in consequence. Adjust the scale after the manner described in the Twelfth Example,

and it will appear as in Figure 4 with 220 volts over the 11 ampere mark, while under the horse-power arrow appears 3.24 e. h. p. which multiplied by 10 gives 32.4 e. h. p. Should the wattage of this combination be desired, reverse the slide as previously described, that is, draw it to the right until 10 volts on the volts lost scale reaches the point occupied by 1 volt in Figure 4. That is a trifle below the No. 3 wire mark. This action has multiplied the reading above the arrow "C" by 10, hence the direct reading so obtained

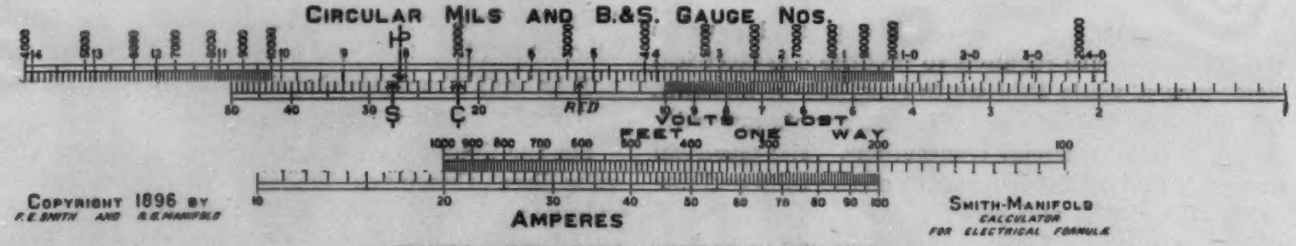


FIGURE 2.—THE SMITH-MANIFOLD CALCULATOR.

(35,600) must be the wattage required, because in assuming 220 volts instead of the 2200 volts given, the given quantity was divided by 10, and in sliding the scale to the right the given quantity was multiplied by 10, therefore the wattage is unchanged.

This mode of procedure gives rise to:

Rule 3. To find the electrical horse-power of a circuit: Read volts direct on the feet-one-way scale; read amperes direct on the ampere scale, then the electrical horse-power of the volts and amperes shown by opposite marks on the feet-one-way and ampere scales is indicated on the volts lost scale by the horse-power arrow direct.

As is well known, the area of a wire may be expressed either in circular mils or in square mils, but the practice of using circular mils is so flexible and has become so general as to give it almost universal acceptance. Nevertheless, there are times when it is necessary to know the square milage of a conductor. A mil is one one-thousandth of an inch, hence a conductor one inch square would measure 1000 mils on a side and have an area of 1,000,000 square mils. The circular mileage of a wire is its diameter in mils squared, hence a wire having a diameter of one inch has an area of 1,000,000 circular mils. Obviously, one circular mils equals .7854 square mils and to reduce circular mils to square mils, or vice versa, involves a tedious arithmetical process. It is not so in using the Smith-Manifold Calculator, however, for when the arrow "C" is placed on a given circular milage, over the arrow "S" appears the equivalent square milage.

Sixteenth Example: What is the square milage of a conductor having an area of 6,950 circular mils?

Place the arrow "C" on 6,950 as in Figure 3, then over the arrow "S" read 5460, the square mils required. To find the circular mils when the square mils are given, simply reverse the order of procedure, and from these methods is derived:

Rule 4. To find the area-equivalents of a conductor: The readings on the circular mils scale opposite the "S" and "C" arrows express direct the area-equivalents in square mils and circular mils respectively.

So diversified are the conditions attending the use of electric conductors that it is impossible to define safe carrying capacities that shall be standard for the various sizes of wire. A given size of wire placed in an iron armored conduit and run in a cold storage warehouse will carry a materially greater current than one incased in a wood moulding and run alongside a hot air flue, for in the first case the heat is conducted away by convection; similarly a given size of wire will not carry the same current when wound on an armature as when strung on a pole line, hence, in figuring the safe carrying capacities, the most general practice has been to determine the carrying capacity first at the rate of 2000 amperes per square inch, and second its carrying capacity at the rate of 1000 amperes per square inch. Given the area of a conductor, its carrying capacity at either of the rates given may be readily determined by arithmetical processes, but the Calculator method affords far greater facility as will be shown by the

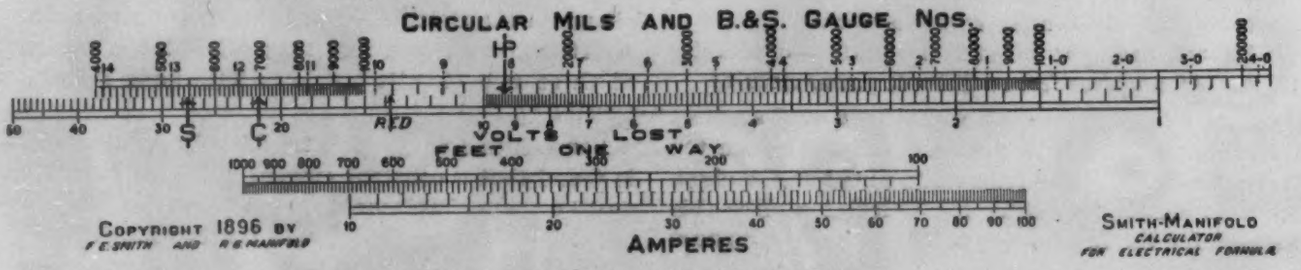


FIGURE 3.—THE SMITH-MANIFOLD CALCULATOR.

Seventeenth Example: What is the carrying capacity of a wire having an area of 20,000 circular mils to be used at the rate of 2000 amperes per square inch.

Place the arrow "C" on 20,000 appearing on the circular mils scale as in Figure 2 and the reading over the red arrow, when divided by 1000, will give the carrying capacity required, which in this instance is 31.5 amperes again:

Eighteenth Example: What size of wire is necessary to carry a current of 10.95 amperes at the rate of 2000 amperes per square inch?

Since in the preceding example it was necessary to divide the reading appearing over the red arrow by 1000 to derive the amperes, it is also necessary in the present instance to multiply the ampereage by 1000 and place the red arrow on the product (10,950) as is done in Figure 3, when over the arrow "C" appears 7,000 circular mils, the area of wire required.

The same procedure is followed in deriving the carrying capacity of a wire figured at 1000 amperes per square inch, with the exception that the ampere reading (multiplied by 1000) appears over the "S" arrow.

Nineteenth Example: What is the carrying capacity of a wire having an area of 20,000 circular mils when figured at the rate of 1000 amperes per square inch?

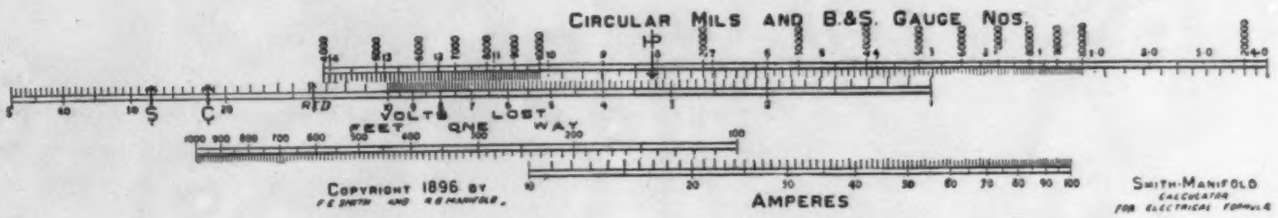


FIGURE 4.—THE SMITH-MANIFOLD CALCULATOR.

Proceed as in the Sixteenth example by placing the arrow "C" on 20,000 and over the arrow "S" read 15,700, which, when divided by 1000, gives 15.7 amperes, the required current. Hence:

Rule 4. To find the carrying capacity of a wire at the rate of 1000 or 2000 amperes per square inch: Place the arrow "C" on the circular milage of the wire designated, and the readings over the red arrow and the arrow "S," when divided by 1000, give the respective amperes the wire will carry at the given rates.

(To be continued.)

A NEW AGENCY FOR INTERIOR CONDUIT.

The California Electrical Works, 409 Market St., San Francisco, has been appointed Pacific Coast agent for the Interior Conduit and Insulated Company, and is prepared to fill without delay, from stock, orders in any quantity for plain, brass, armored or iron armored interior conduit.

This is but one of the many valuable agencies secured by the California Electrical Works, which is fast becoming recognized as the leading electrical supply house of the Far West.

FINANCE, POLITICS AND PROGRESS.

Promoters of electrical or other bonded enterprises who find that their efforts to interest capital in new developments are very arduous, if not almost impossible, because of the probability that the silver question will be reopened as the leading issue of the next Presidential campaign, and because, in consequence, of the still unsettled financial question, will be pleased to learn, on the authority of Finance and Commerce, a leading New York financial journal, that the Republican leaders at Washington are pushing the international bimetallic conference proposition to the front as rapidly as possible. The resolution authorizing President McKinley to appoint delegates to an international conference and to call such a conference, if necessary, which passed the Senate some time since, has been favorably reported to the House without a dissenting vote. This fact was the more noticeable because of the arguments against the resolution which were made before the Committee by representatives of certain business interests. The Republican leaders, it may be stated on good authority, have three distinct and very excellent reasons for pushing this proposition, and pushing it for very prompt action. First, that the party is absolutely pledged to it, and must, in good faith, carry out its pledges; second, that if the proposed silver conference is successful it will take the silver question out of politics, and thus reduce the business uncertainties which now exist; third, that if the conference fails to bring about a method of restoration of silver to its former relation to gold, this fact will show so clearly the impossibility of the United States accomplishing this feat alone, that the demand for the free and independent coinage of silver by this country will rapidly disappear, and thus the business uncertainty as regards the currency will clear away at the same time that the new tariff will improve the business situation in its own field of operations.

THE JOURNAL OF ELECTRICITY.

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EDITORIAL.

CONSULTING ELECTRICAL ENGINEERS

In the engineering world are engineers and—engineers. Similarly and in parallel application but in more significant strain, it has been said that in the mechanical world are "mechanics and—muck-anics, the latter being in vast predominance." Electricity has its full quota of engineers, many legitimate, many spurious, and as will ever be, the usefulness of honest effort suffers by the deeds of the irresponsible.

Should one attempt to grow an engineering tree, he would first plant the seed "engineer" in the soil of civilization, where, moistened by the water of industry and mellowed by the sunshine of progress, will shoot up a sturdy trunk whence bursts forth many branches known to all men by their characteristics. One branch is called "civil engineering," the next one "mechanical engineering," and other is named "hydraulic engineering," and still others, "steam," "marine," "pneumatic," "mining," or "electrical engineering," as are their tendencies. Each branch of this tree, like all others, is numerously divided and the electrical branch which broadly covers the world of electrical development, forks into the stalks of designing, supervising or consulting electrical engineering, whence emanate the limbs and lastly the fruits of electrical development, be they telephony, telegraphy, lighting, power, transmission, electrolysis or transportation. No branch bears the fruit grown on another, and the fruit is perfect only when the blossom is fertilized by pollen. So too, no man may acquire the highest skill in an art without making it his specialty and above all, his work is perfect only when the blossom of theory is blended with the pollen of practice. Without the knife of experience the tree darts up long shoots of aspiration which are frail and sap its vitality; without the pruning shears of education, it becomes scragly, outgrowing itself with the egotism of its own misdirected productiveness. Together experience and education trim each branch to the highest symmetry and fruition.

In general and from their very avocations, consulting electrical engineers appear as advisors on electrical matters. Hence in the eyes of the public they are seen as parties who "know all about" the applications of electricity whatever be their trend. The acquisition of universal knowledge concerning things electrical is impossible, hence it may be contended that the person who, of his own will, adds "electrical engineer" to his name, perpetrates a fraud upon the public in that he assumes to shine in a false light. Not so with the graduate of a duly accredited institution of learning, whose diploma awards him with an electrical engineership, in that he has completed the course of electrical engineering proscribed by the college and therefore has learned everything electrical that that college is capable of imparting, or with the pioneer who, being as a father of the "infant science" has marked and guided the course of his child from its uncertain footsteps of twenty years ago to its robust development of to-day. He, above all others, may, if he so elects, add the symbolic "E. E." to his signature and none will gainsay the propriety of his so doing. Who will question the right of Preece, Kelvin, Thomson, Edison or Tesla to assume the title of electrical engineer, or who will grant the same right to Jeremy Jones, inventor and locksmith, even though he be a centenarian and knows the electrical business to his own satisfaction? Or, again who will grant it unquestioned to the one whose an eminent position in the electrical world, first to a acquiring of an eminent position in the electrical world, is due first to a superficial knowledge of electricity, then to priorty in the field, next to his own artfulness and finally to personal influences and the ignorance of the public concerning matters electrical. Such an instance is not without parallel, be it said with shame.

There is little to be said regarding designing and supervising engineers except that the titles are plain, honest, straightforward. They profess to design electrical machinery or to supervise its installation and no more. Both owe their ability to study and long experience and all honor to the integrity of their titles, but of late it must be said, even though the just suffer with the unjust, that consulting electrical engineering has in the Far West, at least, received a set-back in that the consulting electrical engineer is becoming to be looked upon as a middle-man in the electrical business, as the man who oft-times preys upon the ignorance of capitalist or corporate manager for employment, and who, having acquired authority, uses it sometimes to the injury of both his employer and the contractor, more often to the detriment of the latter. Of the consulting engineer, therefore, words of endorsement may not always be given. When vested with authority he

oft-times becomes an autocrat, heedless of the admonitions of the wiser heads of the parent companies and without regard for the consequences of the follies that his own inexperience leads him to commit. All suffer from his employment and none profit thereby. May this criticism call forth consideration for the just as freely as it utters condemnation for the unjust.

On the Pacific Coast there has been no field of electrical engineering more prolific of strife of this nature than that of transmission plants, and the truth should be heralded that no other lines of electrical work so little requires the services of the consulting electrical engineer as that of the electrical transmission of power. The consulting engineer who, three years or so ago, had the audacity to inveigle capital into employing him for the knowledge he possessed or, rather, for the knowledge he assumed to possess, concerning electrical transmissions, was an arrant imposter, who had at that time never seen a transmission plant and whose only semblance of knowledge concerning one were the few crumbs of information that the designing engineers of the great parent companies had permitted him to pick up from their banquet tables of experimenting. They alone knew, of their own observation, of the hopes and fears with which the electrical transmission of energy was entered upon; they alone experienced the trials and tribulations of early defeat; they alone fought the fight and won the battle over the laws of nature that gave electric transmission commercial feasibility; they alone understood the forces to be handled and the methods yielding control of those forces, and they alone were possessed of the only experience that man had yet had concerning this, the newest, and, in some respects, most noteworthy achievement of the science.

Was it not then with supreme presumption, abetted by a keen perception of future business, that the experience-less consulting electrical engineer glibly charmed his way into the good graces and employment of prospective transmission companies? Again, it is repeated, the consulting electrical engineer of that period was an arrant impostor, and it may be added that transmission projects of to-day stand as little, if not less, in need of his services as then. The Portland, Redlands, Fresno, Santa Cruz, Newcastle and Bakersfield transmission plants attest this. The electric transmission of energy is a creation of such concerns as the General Electric, Stanley and Westinghouse Companies—concerns with whom reputation and motives of self preservation are of infinitely greater influence than the peurile and annoying criticisms of veneered engineers.

Not so, though, with the supervising engineer, who, as stated, occupies his legitimate sphere in a legitimate way. His title explains his office; he should not necessarily take part in the awarding of contracts, for the purchaser must soon learn, if he has not already done so, that any responsible electric company will faithfully execute at least all that it agrees to do. In brief, the supervising engineer is an installing engineer who relieves both purchasers and parent companies from innumerable details that would otherwise prove an embarrassment to the one and a burden to the other. One need not look further than the Riverside transmission to the south or the Copley transmission to the north, to see illustrations of the usefulness of the supervising engineer, but to the consulting electrical engineer, transmission interests of the Pacific Coast may well bid adios.

HIGH POTENTIAL SWITCHBOARDS

It is with considerable satisfaction that reference is made to the leading article of this issue from the pen of so practical an engineer as Mr. C. E. Dutcher. Indeed, in these times it is custom for the theorist or the advertising agent, rather than the practitioner, to monopolize the columns of the electrical press, hence an article such as Mr. Dutcher has presented is doubly refreshing in that it is the fruit of practical experience and in that it represents conditions as they exist in fact and not in mental structure.

The admirable description given of the circuit connections of the Fresno transmission plant leaves nothing to be said concerning the electrical details of construction of high potential switchboard equipments. The manner of building generators and transformers for all classes of work has been exhaustively described in text book and technical press, and is generally understood, and now that Mr. Dutcher has made clear the inner workings of the plant which at once embodies several of the most noteworthy achievements in electrical transmission, there is no longer a cause for misunderstanding the practical details of switchboard and transmission installations. The article is one which all may read with profit.

Passing Comment

An Editorial Review of Current Events and Comtemporary Publications.

THE VALUE OF COLLEGIATE TESTS.

The Wisconsin Engineer, a most excellent quarterly issued by the College of Engineering of the University of Wisconsin, takes issue with an editorial on the above theme which appeared in The Journal of Electricity for August last, in which the practice of publishing the results of comparative tests of commercial apparatus and withholding the names of the makers, was criticized adversely. Without receding from a belief therein implied to the effect that it would be to the advantage of the electrical public if it could be advised of the names of the makers of the appara-

tus tested, we must hasten to assure the Board of Editors of our valued contemporary that the editorial in question was not aimed at the University of Wisconsin, or to any other institution or organization, but that it was directed solely at an almost universal practice which was and is believed to be a subject of adverse criticism. True, the idea threading the editorial was suggested by the appearance of Mr. Ford's "Complete Test of Modern American Transformers" in the Bulletin of the University of Wisconsin. This thesis contained exhaustive data upon the efficiencies, etc., of transformers, but the information loses much value to central stations and installing engineers because of the fact that the names of transformer makers are suppressed. Upon reflection and viewed from the standpoint of pure scientific research, the criticism will be construed by some as unfair; but from the standpoint of the commercial considerations of the many, which after all brings the greatest good to the greatest number, it must be admitted that the contention is a valid one. Nevertheless, let our good friends of the University of Wisconsin be assured of the high esteem in which they are held, individually and as an institution, and above all, let them not take umbrage at a well meant thought that hinges solely upon the point of view.

However, the question involved is one of more than passing interest, hence it is well that the reader may form his own conclusions. After reviewing the editorial referred to, the magazine contiues:

"In the first place we do not agree with the Journal that college instructors should be our guides in determining the best engineering practice. We will leave that duty to the practicing engineers of the country and ask of the instructor that he keep informed as to the best practice and teach it to the engineers of the coming generation. To do this, his laboratory must be equipped with modern appliances, which he should consign to the historical corner as the mould begins to gather. How is he to get modern apparatus? Will the University buy them? Any one who knows the tendencies of the board of regents to limit the apportionment of funds for the engineering department to that of the less expensive departments, will appreciate the difficulty of getting apparatus in this manner. The only other solutions of the problem are to enlist the sympathy of some beneficient millionaire, or else to establish such a reputation for the department that every manufacturer that wants an unbiased test of his product selects that institution to do it. The latter course is precisely the one Wisconsin has pursued. Manufacturers are receiving daily applications from universities and colleges all over the country for apparatus, and their waste baskets fairly groon under the weight of letters from learned professors and enthusiastic students. However, when a Wisconsin instructor or student wants to make a test his application is placed on file and carefully indexed and the desired article is shipped prepaid on the next express. A pleasant letter is sent to the applicant wishing him success in his undertaking and requesting that in case of publication, the identification of the result of the test on this particular pice of apparatus with the maker's name, be left entirely to the discretion of the latter. He knows about Wisconsin's tests on transformers, on alternating current motors, on steam injectors, and a dozen other things; he knows that the transformer tests caused many reputable manufacturers to change their design; that the late tests on alternating current motors indicate a like result; that the injector tests point out the particular field for each type of injectors, and that perhaps he likewise may be put on the right track; or, if already there, he wants a check on the work of his own men and a recommendation from an unbiased institution of reputation. We do not call this purchasing silence.

"Now let us see about the benefit of these tests to the community. What engineer would advise his company to buy the apparatus of Jones & Jones just because that firm made a good showing in a comparative test of apparatus, which they knew would be tested? Here their success is only a criterion of what they can do; not what they do do. The name of the maker might as well, then, be omitted in the publication of results, and the value of the publication is this: first, it gives the standard to be expected from first-class apparatus, and second, the method of testing is given that a purchaser may himself make tests on his own goods before accepting them."

Literature.

Any Book Published Mailed upon Receipt of Price by The Journal of Electricity.

ROENTGEN RAYS AND PHENOMENA OF THE ANODE AND CATHODE: By Edward P. Thompson, M. E., E. E., with concluding chapter by Prof. Wm. A. Anthony. 12mo cloth, 190 pages, 60 diagrams and 45 half-tones. Published by D. Van Nostrand Co., New York, 1896. For sale by Geo. Webb Alexander, 401 Market St., San Francisco. Price $1.50.

Lord Kelvin, after receiving the book now under review, was so impressed with its sphere of usefulness in the scientific world, that evidently his appreciation could find most suitable expression in departing from a long fixed custom to the extent of writing the author lines of endorsement that, in the eyes of the scientific world, will be viewed as an expression of approval from the highest living authority. "I received it only a few days ago," wrote Lord Kelvin, "but I have already looked nearly all through it with great interest. I have seen enough to know that I shall find much most

useful information in it which will always be readily available because of the very excellent method and care with which you have given references to authors, dates and publications, and I am sure that all who are interested in the subject will find your book exceedingly valuable. All your statements with reference to anything I have done on the subject are perfectly correct."

After such an expression of opinion from so eminent an authority, there is little left the reviewer but to outline the scope of the work. Except with the ardent enthusiast in X-Ray experimenting, the public at large, and even to a great extent the technical public, has become rather surfeited with literature descriptive of Roentgen phenomena, and the confession is frankly made that Thompson's book has lain almost unopened on the reviewer's table for weeks for the reason stated. To make the confession complete, however, it must be added that these weeks were, from the standpoint of added information concerning the very important branch of technical knowledge, as a long period of darkness that is now almost dispelled. No one as yet grasps the science of radiography with clearness and distinctness, so to speak, as of the light of day, but all will find the dawn in Thompson's interesting work.

Roentgen Rays is written for the information and guidance of advanced investigators, more especially than for amateurs and spasmodic enthusiasts. Indeed, any work which, without qualification or qualm, makes commonplace use of such a word as "pentadecylparatatolylketone" is clearly not intended for the purposes of kindergarten instruction. The work is a laboratory rather than a workshop handbook and the experimenter in quest of detailed information enabling the construction of induction coils, condensers, Crook's tubes, fluoroscopes, sciascopes, or other paraphernalia of radiography, must look elsewhere, but if outlines and lessons of the researches of scientists from the earliest days are desired, here they will be found most admirably arranged and sufficiently exhaustive to enable an accurate technical understanding of the progress that has been made step by step toward a solution of the problems presented in the phenomena of the anode and cathode.

As an example, the author describes one of Tesla's experiments, showing the expulsion of material particles through the walls of a discharge tube and in order to illustrate the manner in which experiments are described, the following abstract is given:

"At quite a low vacuum and after sealing off the lamp, Tesla attached its terminal to that of the disruptive coil. After a while, the vacuum became enormously higher, as indicated by the following steps: first, a turbid and whitish light existed throughout the bulb. This was the first principle characteristic. Next, the color changed to red and the electrode became very hot in that case where the powerful apparatus was employed. The precaution to be taken is to regulate the e. m. f., to prevent destruction of the electrode. Gradually the reddish light subsided and white cathode rays, which had begun, grew dimmer and dimmer until invisible. At the same time the phosphoresecent spot became brighter and brighter and hotter and hotter, while the electrode cooled, until the glass adjacent thereto was uncomfortably cold to the touch. At this stage the required degree of exhaustion was reached, and yet without any kind of a pump. From the fact that the vacuum became higher and higher by the means stated, Tesla was very much inclined to believe that there was an expulsion of material particles through the walls of the bulb, where these particles, which were passing with very great velocities, struck the sensitive photographic plate, they should produce chemical action. He referred to the great velocities of projected particles within a discharged tube and to Lord Kelvin's estimate of the same, and reasoned that with high potentials the speed might be 100 kilometers per second. No stronger proof as to the expulsion of material particles could be desired than an operation in which the eyes can see for themselves that such an action must have taken place. It was extraordinary that a visible but fine hole was made through the wall of the tube and especially that no air rushed into the vacuum. On the other hand, the pressure of the air was overcome by something rushing out of the tube through the hole. The glass around the hole was not very hot, although if care were not taken it would become much hotter and soften and bulge out, also indicating a pressure within greater than the atmospheric pressure. He maintained the punctured tube in this condition for some time and rarifaction continued to increase. As to the appearances, the streamers were not only visible within the tube but could be seen passing through the hole, but as the vacuum became higher and higher, the streamers became less and less bright. At a little higher degree of vacuum the streamers were still visible at the heated spot, but finally disappeared."

The whole work is filled after this manner with descriptions of experiments, nearly half of which lead the reader up to the time of Roentgen's discovery. There are included among many others, the brilliant researches of Lenard, Hertz and Crookes, together with a host of later investigators that have followed Roentgen's lead. Throughout the work the author has adhered to the plan of German investigators in publishing accounts of their experiments by means of numbered paragraphs containing numerous cross references, and the reader finds that the idea wonderfully facilitates his endeavors to keep his memory refreshed. Credit is given to authors and publications from which extracts are made, but The Journal of Electricity has cause to complain that it alone fails to be properly accredited in bringing out exhaustively the interesting and original experiments of Dr. Phillip Mills Jones, which are briefly referred to.

Personal

Mr. J. W. Godfrey, "Genial Jim" of Habirshaw wire fame, agreeably surprised his many San Francisco friends by making them an unexpected visit week before last.

Dr. Thos. Addison has been tendered the position of General Manager of the Federal system of the City of Mexico, which recently passed into the control of a syndicate of South African multi-millionaires and which embraces the entire electric and railway interests of that city, but being loathe to leave this country, the offer was declined.

Mr. John S. Eastwood, whose portrait appears on this page and whose experience in the construction and

JOHN S. EASTWOOD.

operation of the San Joaquin Electric Company's plant at Fresno, Cal., has given him invaluable information concerning the longest distance high potential transmission plant in the world, is a very progressive young man and an active member of the "Hundred Thousand Club" of his adopted city. By profession a civil engineer, practicing mainly in and about Fresno County, he has had long familiarity with the water powers of the Sierras thereabouts, and when the wood had through commendable foresight, secured the water right which is at once both the largest and most available in Central California and which has now for a year past, been furnishing power for the operation of the San Joaquin Electric Company. The development of this plant, which is also noteworthy as operating Pelton wheels under the highest head of any other electric plant in the world (1410 feet), is largely due to the farsightedness of Mr. Eastwood and to the financiering ability of Mr. J. J. Seymour, President of the Fresno Water Company and President and Manager of the San Joaquin Electric Company. Though making no pretensions to electrical engineership, Mr. Eastwood has, perforce, acquired an excellent knowledge of electrical transmissions and his extended practical experience has given him a vast fund of most interesting and valuable experience in the art that, from present indications, will prove man's chief means of securing power when the coal fields shall have "gone dry."

Obituary

HARVEY LAMB LUFKIN.

It is a sorrowful task to record the death of H. L. Lufkin, one of the brighest, ablest and most agreeable personages that ever travelled in the interests of an electrical concern and than whom no salesman ever left a broader wake of friends to mark his tours throughout both East and West. Mr. Lufkin died in New York City on December 21st last, after an illness of but four days.

Born in Cleveland, Ohio, in 1857, Mr. Lufkin entered the electrical business when 24 years of age and in 1886 he became associated with Messrs. Curtis, Crocker & Wheeler in establishing the C. & C. Electric Motor Company and played an important part in introducing and developing electric power. He was one of the very first to operate electric motors on arc and incandescent circuits, despite of the strong opposition of the central station officials who looked upon the innovation as a dangerous experiment. That there was wisdom in his contention is now known and fortunately he lived long enough to see electric power distribution become a very large and welcome part of the business of central stations. He was a distinctive pioneer in applying electric motors to the operation of factories and mills to the displacement of line shafting, and also had the satisfaction of witnessing the success and general acceptance of this improved method.

His long prominence in the electrical field and his intimate relations with many of the best authorities in its ranks had endeared him to those who now mourn his loss, and those who knew him will most warmly appreciate the words of Prof. F. B. Crocker, who, in testifying to Mr. Lufkin's personality, stated that he possessed the rare combination of technical knowledge with great business ability, enabling him to accomplish results which would be impossible for a man having either one of these qualities alone. This advantage, together with his excellent judgment, prevented him from making the mistakes which are so common in the development of a new art, and gave him a power to foresee the probable directions of successful prog-

ress, two examples of this prescience having already been noted. Although enthusiastic as to the value and possibilities of electrical applications, his good sense told him just where to stop, and it often happened that he would advise against the use of electrical apparatus when he did not think that it had decided advantages over other means, even though the electrical method might be feasible. Mr. Lufkin was a very active member of the National Electric Light Association. He was an associate member of the American Institute of Electrical Engineers, and was a leading spirit in organizing and making a pronounced success of the Electrical Exposition held in New York City during the spring of 1896.

Possessing an unusually bright and agreeable personality, he was universally popular among electrical men, and was sincerely liked by his friends and business associates. His sudden death in the prime of his ability and usefulness is a great loss to the electrical industry, which always requires the services of men of exactly his stamp.

The Lay Press.

POPULAR REFLECTIONS OF THE CONDITIONS AND PROSPECTS OF ELECTRICAL ENGINEERING ON THF PACIFIC COAST.

SAN DIEGO'S ELECTRIC BAKERY.

William Hilts, proprietor of the Detroit Bakery, 1154 Fourth St., is the first manufacturer in San Diego to introduce electricity as a heating and cooking agent. When seen last night he said nothing could beat its work. He had baked bread, cake, pies and everything used by him with the new heat, and found it the most perfect of anything he has ever used. The entire work of the bakery is done by the aid of this powerful agent. A motor runs his kneading machine, carries the dough to the oven on cars, lights his room, and last of all cooks the dough. The plant is one put up by Electrician Earl Richardson, of the Traction Company, the current being furnished by the plant of that Company. The bottom of the oven is lined with wire-covered-heaters, which generate heat at such a rapid rate that it takes only a few minutes to heat the entire oven. The generators are also being made for his largest oven, capable of baking 200 loaves of bread in one batch.—San Diego Union.

INTER-URBAN ELECTRIC ROADS IN SOUTHERN CALIFORNIA.

Some extensive electric railway building in this section will be done during the coming year. At the present time there are two agents of Eastern capitalists in this city looking over the field and making plans for future operations. So far, however, no more than a mere outline of what is contemplated is hinted at. These representatives from the East consider this a great field for investment. They are satisfied that there will be an enormous influx of people to Southern California during the next five years. And this population will go to the country and small suburban towns. This is how the railroad people argue. Electric roads have been a great boon to people who prefer to live outside the the large cities. Rapid transportation at all hours of the day and night has made it possible to have a home in the suburbs and do business in the city. The electric road to Pasadena and Santa Monica illustrates this idea very forcibly.

A move is on foot to electricize the horse-car line between the Soldiers' Home and Santa Monica. Work will commence at an early date. The proposition to put a road through to La Canada and around by Glendale is more than likely to result in something tangible. The projectors have had considerable encouragement from people who own property along the proposed route. The country is but sparsely settled as yet, owing to the lack of transportation facilities; but with an electric road there would be great inducements offered to home seekers. La Canada is one of the most picturesque and healthful sections in this whole region. The soil is all that could be desired and there is an abundance of water.

Some time ago there was gossip to the effect that an electric road was under consideration between Los Angeles and Whittier. The dull times and tightness of the money market choked off the enterprise. But the scheme has again been revived. Then there is that belt line that is to take in Long Beach and San Pedro. That proposition is not dead by any means. In fact it is more alive than ever before. The people back of this enterprise declare the line will be built before the end of two years.—Los Angeles (Cal.) Express.

Reports of the Month.

LITIGATION.

Los Angeles, Cal.—The Los Angeles Electric Co. has sued Chas. Bauer of the Anhauser saloon for $200, alleged to be due for breach of an electric lighting contract.——A similar suit for like amount has also been brought against the McInnes Bros.——T. J. Henderson, administrator of the estate of Charles C. Odell, has been ordered by Judge Clark to accept the sum of $2,890 from the Los Angeles Electric Railroad Company for the killing of Charles Odell some time ago.

Salt Lake City, Utah.—Lizzy Wolfley, a domestic in the family of R. M. Jones, has sued the Salt Lake & Ogden Gas & Electric Co. for $5,000, alleging injuries received by the potential of a 1140 volt primary circuit reaching the interior wiring through a defective transfomer.

INCORPORATION

Downieville, Cal.—The Downieville Electric Co. Capital stock, $25,000. Directors: R. Forbes, E. Macdonald, A. Denmire, W. V. Lockwood, R. B. Elder.

Los Angeles, Cal.—The Wybro & Lawrence Co. Capital stock, $50,000. Directors: H. C. Wybro, G. W. Lawrence Sr., Geo. W. Lawrence Jr., L. W. Boynton and F. W. Burnett. Objects: The buying, selling and manufacturing of machinery and electrical apparatus.——The Home Telephone Co. Capital stock, $50,000. Directors: F. W. Brawn, President; A. C. Cass, Vice-President; A. C. Jones, Treasurer; Louis F. Vetter, Secretary and John D. Works. Chas. E. Severance is General Manager. Objects: To establish a telephone exchange in this city using apparatus of the Standard Electric Telephone Company of Madison, Wis.——The Wright Wave Motor Co. Capital stock, $1,000,000, in 10,000 shares of $100 each. Directors: Parvin Wright, Shirley C. Ward, John S. Ward, K. W. Midowicz all of Los Angeles, and Jefferson Chandler of San Francisco. Objects: To acquire the ownership of wave motor patents, rights of water frontage and the generation, transmission and sale of electrical or other power created by wave motors.

Mendocino, Cal.—The South Park Railroad Co. Capital stock, $100,000. Incorporators: T. D. Riordan, E. Lande, J. J. Quinn, J. M. Hanley and F. H. Ransom. Objects: To build three miles of railroad along the windings of the South Fork of Flynn and Albion Creeks.

Napa, Cal.—The Sonoma County Land & Power Co. Capital stock, $100,000. Incorporators: R. H. Warfield, Geo. Stone, B. M. Spencer, M. W. Griswold and J. F. Byxbee. Objects: To

supply power and light to Napa, Mendocino, Lake and other counties.

Nogales, Ariz.—The Duquesne and Nogales Telephone and Telegraph Co. Capital, $5,000. Directors: J. S. Tebbits, Wm. Roy, Edward Titcomb. Objects: To construct, maintain and operate telephone and telegraph systems in Arizona.

San Francisco, Cal.—The Golden Gate Electric Co. Capital stock, $250,000. Incorporators: F. G. Cross, Geo. E. Whitaker, C. M. Cross, M. O. Robinson and B. J. Parker. Objects: To purchase and lease real estate and to erect suitable buildings for the purpose of supplying electricity in this city and vicinity.—— The Acme Electric Manufacturing Co. Capital stock, $50,000. Incorporators: W. T. Y. Schenck, L. St. D. Roylance, S. B Peterson, F. J. Dyer and W. S. Schenck.

Woodland, Cal.—The Washington Water and Light Co. Objects: To furnish this town with water and electric and gas light.

COMMUNICATION.

Carson, Nev.—The press dispatches sent from Carson during the afternoon and evening following the Corbett-Fitzsimmons fight aggregated about 400,000 words. A force of forty operators was required to handle that amount of matter. The officers of the Western Union Telegraph Company consider that in getting the dispatches through to nearly every town, village and city in the United States and Canada in time for the newspapers, from such an out-of-the-way place as Carson, they performed a feat that has never been equaled in the history of telegraphy. Up to the time of the fight there was only one wire in Carson. It ran from Reno, a distance of thirty-two miles, where connection was made with the trunk wires along the line of the Central Pacific Railroad. That wire was sufficient for all ordinary service, but, of course, was totally inadequate to carry even the private messages in connection with the great fight. Superintendent Jaynes grasped the situation, and a month ago went to Carson for the purpose of arranging to give a perfect telegraph service. Eight additional wires were strung from Cason to Reno, and there the through lines were split. Operators at Carson worked direct with Chicago over the Eastern wires from Reno for as much as those wires would bear. Then as many more worked direct to San Francisco over the wires west, and here the matter was repeated to Eastern points over the Northern and Souhern routes.

Every word of the matter filed was carried through to the editorial rooms of the papers all ove America in time for publication in the morning. Most of the dispatches were for Eastern papers, and owing to the difference in time the dispatches were required in their offices at least three hours before the time the papers on the Pacific Coast went to press. That no complaints of late delivery were made is something of which Superintendent Jaynes is naturally proud.

City of Mexico, Mex.—The operators of the Mexican telegraph line have organized a brotherhood and the new society was duly inaugurated on February 6th. Mr. Augustin M. Chavez, Director General of the Federal Telegraphs in the Republic, was in the chair and delivered an appropriate address. The portrait of Mr. Juan de la Granda, who introduced telegraphy in the Republic, adorned one of the walls.

Los Angeles, Cal.—The Home Telephone Co. has taken offices in the Bradbury building and is canvassing the city for telephone subscribers. It promises to cut existing prices 50 per cent and to place wires underground in the business section.

San Diego, Cal.—The Southern California Mountain Water Co. has been granted a franchise under ordinance No. 415 conveying the right to install a telephone or telegraph system including poles, conduits, wires, cables or other conductors along certain streets.

Santa Barbara, Cal.—F. T. Buell has sold a right of way for a pipe line and telephone line across the Rancho San Carlos de Junata to Wm. H. Crocker.

Spokane, Wash.—The President of the Spokane & Columbia Telephone and Telegraph Co., states that within the next six months Spokane and the British Columbia towns of Roseland, Trail and Nelson will be all joined by telephone. The new telephone line will probably follow the wagon road from Spokane to Rossland, and thence in the best route to Trail. A line will be built into the Slocan country during the summer by way of Waneta and Salmon to Nelson and other points, to reach all the principal towns in the Boundary and Slocan districts.

ILLUMINATION.

Anaheim, Cal.—On March 11th, the city Trustees rejected all bids for the proposed municipal lighting plant and instructed their supervising electrical engineer, E. C. Sharpe of Los Angeles, to draft new plants and specifications for the work.

Arroyo Grande, Cal.—The Board of Directors of the Templeton Milling Co. aredesirious of learning whether an electric light plant would be a paying addition to the mill.

Astoria, Or.—The Council is discussing the feasibility of a municipal lighting plant.

Baker City, Or. The Baker City Elec. Light Co. is installing a 150 kw. monocylic generator including all station instruments and

Belvedere, Cal.—Signatures are being obtained for the establishment of an electric light plant.

Benicia, Cal. Ordinance No. 45 has been passed granting a franchise to the Solano Electric Light & Gas Co.
transformers.

Ben Lomond, Santa Cruz, Co., Cal.—Thos. L. Bell has installed an isolated incandescent plant run by water power for lighting the cottages of his summer hotel.

Cnetralia, Wash.—An extension to the electric lighting plant is contemplated.

City of Mexico, Mex.—The Mexican General Elec. Co. has closed a contract for a plant for the city of Hermosillo, Sonora.

Ellensburg, Wash.—A proposition is being considered by the question of an electric light plant.

Emeryville, Cal.—The Oakland Gas, Light & Heat Co. has petitioned for an electric light franchise.

Etna, Cal.—The April meeting of the Board of Directors of the Etna Development Co. will probably take definite action on the city Council for transforming the electric light plant from steam to water power, which will effect a saving of $250. per month. It is believed that the Damman water power and mill property can be bought for $9,000, in which event the cost of the change will be about $13,000.

Fresno, Cal.—The La Favorita and Paragon vineyards are to be lighted by electricity from the circuits of the San Joaquin Elec. Co. E. D. N. Lehe of Stockton has secured the contract for the wiring and it is stated that the vineyards are 45½ miles distant from the power house.

Fullerton, Cal.— This town is aspiring to an electric light plant.

Healdsburg, Cal.—The new city water works will probably be run by steam power for the reason that the boilers could be used for an electric light plant should the city so desire.

Johaanesburg, Cal.—G. W. Chrisman of the Ventura Elec. Light & Water Works contemplates putting in an electric plant here for both power and lighting purposes.

Kamloops, B. C.—Jas. Delany has sold the electric lighting plant to Wm. T. Stewart.

Los Angeles, Cal.—The West Side Lighting Co. has applied to the Council to be relieved of the license of $100 per month required by ordinance from all electrical lighting companies doing a business of $250, a month and over.

Riverside, Cal.—The municipal plant is now operating above 2,100 commercial incandescent lights.

Medford, Cal.—Jas. Anthony of Butte County, Cal. is in this city with a view of locating an arc electric light plant.

Mercur, Utah.—Orders have been given to install an electric light plant in the Mercur mines.

Nogales, Ariz.—The Nogales Electric Light Co. has just installed a new 100 h. p. Corliss engine and two 1,000 lighters.

Nelson, B. C.—The Nelson Electric Light Co. contemplates ex-

tensive improvements and additions to its plant during the next 60 days.

Phoenix, Ariz.—The Phoenix Light & Fuel Co. have been granted a gas franchise.

Payson, Utah.—The Payson Elec. Light & Manfg. Co. has assigned, making T. G. Wimmer assignee. The assets are placed at $8.050, and the preferred credits are $2,358.60.

Pleasanton, Cal.—John Thiesen has applied for an electric light and water franchise.

Porterville, Cal.—W. H. Norris and Adolph Willson have been granted a lighting franchise.

Pasadena, Cal.—The Council is considering the advisibility of bonding the city for $10,000 for the purpose of installing a municipal lighting plant.

Pullman, Wash.—H. J. Jackson has applied for an electric light franchise.

Prescott, Ariz.—A municipal plant costing $6,000 is talked of.

Sacramento, Cal.—A special committee appointed by the Board of Trustees to investigate the cost of installing a municipal lighting plant has reported that such an installation would cost $40,000 and the recommendation was made that the corporation council be instructed to draft an ordinance for submitting the proposition to the people at a special election.

Salem, Or.—The Trustees and Superintendent of the Oregon State Insane Asylum have recommended an extension of the electric lighting plant and the installation of a storage battery in that institution.

Salt Lake City, Utah.—Mr. Dignowitty, a mining promoter of this city, has located a mill site on Bullion Creek, where a lighting installation will be placed.

San Diego, Cal.—Mr. E. C. Sharpe the well known supervising electrical engineer of Los Angeles, has made a proposition to the City Council to build a first class electric lighting plant for the city with all the latest improvements and let the city pay for it in installments covering a period of five years. The matter has been taken under advisement.—The Theosophists propose to install an electric lighting plant for lighting the temple and its adjoining buildings and grounds. Ernest Hargrove is President.

San Francisco.—Supervisor Rottanzi is favoring the installation of an isolated lighting plant in the City Hall.

San Pedro, Cal.—It is reported that the Long Beach and San Pedro Electric Light Co. will move its plant from Long Beach to this place in April.

Selma, Cal.—A mass meeting of citizens has passed a resolution showing it to be the sense of the meeting that the town be bonded for $15,000 for the construction of a light and water plant and a committee consisting of J. A. Burns, H. G. Drew and J. W. Aiken were appointed to determine the cost.

Shalam, N. M.—A. M. Howland is to make a health resort of Levitica and among other improvements will install an electric light plant there.

Silver City, N. M.—M. W. Neff is arranging to install an electric light plant here.

Sitka, Alaska.—California parties are endeavoring to organize water and electric light works here.

Spokane, Wash.—City Commissioner J. T. MacLean is urging that $45,000 be expended in increasing the 1,500 h. p. pumping plan now used by the city water system, to 3,000 h. p., which will permit the installation of 2 additional pumps and the addition of an electric light plant that would furnish three times as many street lamps as are now in use. He estimates that the city would save $3,700 a year by the change.

Stockton, Cal.—The Stockton Gas & Elec. Co. is at work on plans for the new power house, and the new works when completed will be run by gas engines.

Ukiah, Cal.—The Mendocino Elec. Light Co. has been granted a lighting franchise.

Ukiah, Cal.—A new company consisting of W. S. Lockwood, P. S. Taylor, Frank Morse, W. A. Hagans and T. A. Templeton is to install an opposition electric light plant here; the company is capitalized at $20,000 of which $12,000 is paid in.

Vancouver, B. C.—The new Selevor smelter to be erected here will be lighted by electricity.

Whittier, Cal.—A combined electric light and ice plant is under consideration.

Williams, Ariz.—The Saginaw Lumber Co., which is rebuilding its immense mills at this place, will light them by electricity.

Woodland, Cal.—The Washington Water & Light Co. have applied to the Board of Supervisors for a franchise and right of way in the town of Washington.

TRANSMISSION.

Bakersfield, Cal.—The first trial run of the generators in the power house of the Power Development Co., was made on February 17th, and a few days thereafter the plant was placed in successful operation. The equipment of the plant has been described in these columns. All apparatus is of General Electric make.

Great Falls, Mont.—The Boston and Great Falls Electric Light Co. has contracted to furnish electric power for a term of years for the operation of the Silver smelter, and as a result the plant of the electric light company is to be increased.

Mesa, Ariz.—Dr. A. J. Chandler, Supt. of the Consolidated Canal, is making satisfactory progress in the development of the water power. Five hundred horse power is now available with a fall of 39 feet which can be easily increased to generate 800 horse power. This power will doubtless be used by electrical means for pumping water into the irrigating canals.

Monterey, Cal.—On April 1st, the Monterey Power Co. will open bids for the installation of its entire plant including dam, flume, wheels, electrical apparatus and pole line from Little Sur River (22 miles south of Monterey City) to Monterey and Salinas City, for the generation and transformation of electrical current of not less than 450 horse power; entire distance being approximately 37 miles. Major Phillip P. Dandridge, a civil engineer late of Redding, is to have charge of the work which it is expected will be completed late in August. The construction will include 9,600 feet of fluming, which will furnish 2,000 inches of water at a head of 210 feet.

Oakland, Cal.—The most promising scheme yet broached for the transmission of power to Oakland or San Francisco, is that developed by Dr. Thos. Addison, Manager of the Pacific Coast office of the General Electric Co., which consists in placing a steam plant at the coal mines of Corral Hollow and transmitting the power to Oakland, 42 miles. The present plans call for the transmissions of 6,000 horse power, but the transmission company has a contract with the Corral Hollow mines by which the latter agree to furnish enough coal either waste or merchantable to generate 10,000 horse power continuously. The capital for the installation has been secured but it is deemed advisable to await a demonstration that the coal mines will be able to furnish the amount of fuel contracted for. It is stated hat the Oakland Gas Light & Heat Co., and the Alameda Railroad have agreed to take power and no doubt is entertained that other electrical enterprises will find transmitted power cheaper than it will be possible to generate.

Portland, Or.—The Portland General Electric Co. has concluded to extend Station B at Oregon City, which contains the three-phase General Electric plant described in the "Journal of Electricity" for December, 1895, by the addition of two sections. This is in addition to the 12 foot extension which has lately been completed and the new extension will be 32 feet long conforming with the remainder of the structure. The projected extension will include two sections, and be 32 feet long, built the same as the remainder of the structure. The first part completed was 80 feet long, so the extension to be made will make the structure 124 feet in length. with 14 sets of turbines, each set operating a 600-

horse power dynamo, except the set that actuates the pumps. Further extension of the power house will be made as soon as the power is needed. The division wall between the boat canal and the feed channel for the power house is now being built. It must be anchored to the solid rock toward the bluff, to do which it will be necessary to let the water out of the canal.

Santa Cruz, Cal.—Mr. and Mrs. F. L. Robinson have sold their interests in the Big Creek Power Co., to F. W. Swanton and the present owners of the company are Wm. Rennie, Henry Willey, F. W. Swanton and wife, A. P. Swanton, A. A. Morey of Santa Cruz and Mayfield Smith of San Jose.

Redlands, Cal.—One of the most ambitious electrical transmission plants yet proposed and which appears to be one that will first be realized is that of the Southern California Power Company of this city, which has been recently organized by Henry Fisher, President of the Fisher Oil Company of Pittsburg and H. H. Sinclair, President of the Redlands Electric Light and Power Co. The company, which has $1,000,000 capital, proposes to develop the power of the Santa Ana river by taking water out at the junction of Bear creek and Santa Ana river, carrying it in a cement ditch and tunnels about four miles, thus securing a fall of from 1,000 to 1,100 feet, and then returning the water again to the stream. The amount of power will be 1,000 horse power. This will be transmitted by a pole line 75 miles to Los Angeles, there to be used to supplant the steam power now used to develop electricity for the lighting companies and street railroad companies. It will be the longest line and handle the highest voltage (30,000 volts) in use in the world. The line will supply San Bernardino, Pomona, Ontario and Pasadena, and the company will be independent of the present Redlands company, but will work in harmony with it, especially as to interchange of power when necessary. The Redlands company now has 1,000 horse power in machinery installed at its power house on Mill creek, and has just bought enough land in Mill creek canyon to enable it to develop 15,000 horse power more. Work will be begun in Santa Ana canyon as soon as surveys are completed, which will be about April 1. It is proposed to deliver power at Los Angeles by January 1, 1898. The Company has already closed a five-year contract with the East Riverside Irrigation Co. to supply it with electric power for pumping purposes and its officers are at present negotiating for the supply of electric power to the various electrical enterprises in San Bernardino.

San Bernardino, Cal.—The San Bernardino Electric Light Co. is to increase its capital stock from $50,000 to $100,000, which will enable the acquiring of the East Riverside Water Power plant having a capacity of 250 horse power, which, together with the 150 horse power in water power available from the Kehl ditch at the present plant, will give the company 400 horse power in water. In addition arrangements have been concluded with the Redlands Electric Light and Power Co., by which an additional 500 horse power can be secured when desired. Among the other extensions considerable street railway work is contemplated.

Marysville, Cal.—F. W. Page has applied for an electric lighting and power franchise which is to be operated in conjunction with the system he proposes to install for lighting Marysville, Yuba City and the surrounding Brown's Valley country.

Mokelumne Hill, Cal.—Some very thorough work is being installed at the power house of the Blue Lakes Company. The structure is of steel measuring 35 by 150 feet, resting on a foundation of solid rock and concrete. A 10 ton travelling crane has been placed therein for handling machinery which will consist of three 450 kw Stanley two-phase inductor generators to be direct driven by P tangential water wheels made by the Abner Doble Company of San Francisco. The wheels are to be quadruple nozzle and to be driven under a head of 500 feet.

MISCELLANEOUS.

East Helena, Mont.—The United States Smelting and Mining Co. will introduce the electrolytic process in its works.

Los Angeles, Cal.—Hugh T. Duff and Geo. E. Nolan have formed a co-partnership known as the Machinery and Electrical Co., and as such have succeeded to the business of the Machinery Supply Co.

Sacramento, Cal.—Governor Budd has vetoed Senate Bill No. 9 which was designed to grant to the Trustees of the cities of Alameda, Berkeley and others in the same class, power "To purchase, lease or construct water works and electric plants, and all machinery, conductors and appliances necessary therefor and to supply such city with and to sell to the inhabitants thereof, water, light, heat and power, etc." The Governor maintains that the questions involved should be submitted to the vote of the people.

San Francisco, Cal.—Local Union No. 6 of the National Brotherhood of Electrical Workers has elected the following officers: Past president, D. Keefe; president, A. C. Johnson; vice-president, G. P. Manning; treasurer, D. Keefe; financial secretary, J. R. Fulton; recording secretary, J. J. Cameron; foreman, H. W. Pierce; inspector, J. A. Barnhart.

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